

The foregoing detailed description is illustrative of a particular embodiment of the invention, and it is to be understood that through changes and modifications additional embodiments may occur to those skilled in the art without departing from the spirit of the present invention. The embodiments described herein together with those additional embodiments are considered to be within the scope of the invention.

I claim:

- 1 A retrieval device for capturing and recovering small articles, operated by a moving air stream by adaptably connecting it to a vacuum cleaning system, said retrieval device comprising:

a rigid elongated annular air tube including a primary inlet opening, a medial region defining an intermediate air exit passage, internal diverting means cooperating with said intermediate air exit passage in re-directing the air stream, one or more air re-entry passages extended away from said intermediate air exit passage, and a final outlet opening, whereby the air stream enters said air tube at said primary inlet opening, flows toward said diverting means, exits said air tube through said intermediate air exit passage, re-enters through one or more of said air re-entry passages, then exits said retrieval device through said final outlet opening;

a hub mounted rotatably and slidably on said air tube, including positioning means, whereby said hub is continually held in a discrete first longitudinal position with respect to said air tube, while being free to rotate about its center through 360 degrees in either direction, said hub further including a circular portion extending radially outward with a flange at its distal perimeter, said circular portion and said flange defining the top closure of the next element;

a jar of substantially cylindrical shape, comprised of a translucent plastic material for providing a clear view of its contents, fixedly mounted at its upper extremity to

said flange of said hub by means permitting manual removal, said jar including a bottom surface and a sleeve portion rotatably and slidably adapted to said air tube, whereas said jar forms a vacuum tight compartment surrounding said air tube in the area encompassing said intermediate air exit passage and said air re-entry passages, thereby enabling continual airflow between the said internal air passages, whereby every object traveling within the air stream must traverse, at a minimum, the space within said jar between said intermediate air exit passage and said air re-entry passages;

a filter element, substantially cylindrical in shape, mounted fixedly to said hub, surrounding said air tube in close rotatable and slidable contact, said filter element including a multiplicity of filtering orifices of uniform size, and means bringing said filtering orifices into alignment with said air re-entry passages of said air tube whenever said hub is in said first longitudinal position, whereby the air stream exits said air tube through said intermediate air exit passage and re-enters it by first passing through said filtering orifices and second through said air re-entry passages, thereby causing objects transported by the air stream which are smaller than said filtering orifices to pass freely through, and causing objects larger than said filtering orifices to remain trapped within said jar between said filter element and said intermediate air exit passage;

- 2 the retrieval device of claim 1 wherein the aggregate of said air re-entry passages is radially disposed 180 degrees with respect to said intermediate air exit passage for causing the air stream to describe a cyclonic path, thereby inducing orbital motion of articles entrained in said air stream for enhanced recognition and for separation of those heavier than air by centrifugal force;
- 3 the retrieval device of claim 1 wherein the region inside said jar that is located between the bottom edge of said intermediate air exit passage and said bottom surface of said jar is of optimal dimensions, so as to comprise a region of lowest

air turbulence, whereby the effects of separating heavier than air articles and settling them within said region are maximized;

- 4 the retrieval device of claim 1 wherein said region within said jar that is located between said bottom edge of said intermediate air exit passage and said bottom surface of said jar comprises a holding area whereby, after the vacuum air stream is turned off, captured articles are prevented from falling back out of said air tube through said intermediate air exit passage;
- 5 the retrieval device of claim 4 including releasable positioning means, whereas said hub is released from said first longitudinal position and free to move slidably to a second range of longitudinal positions defining a self-cleaning position range, in which said filter element substantially surrounds said air tube within the region occupied by said intermediate air exit passage and by said air re-entry passages, and further, wherein said filter element incorporates a full open air re-entry orifice extended away from said multiple filtering orifices, whereby the air stream exiting said air tube through said air exit passage flows through said multiple filtering orifices in the reverse direction, thereby dislodging residual debris having clogged said filtering orifices when said filter element was in said first longitudinal position, said air stream then completing its path through the interior of said jar, through said full open re-entry orifice of said filter element into one or more of said re-entry passages of said air tube and out through said final outlet opening, thereby removing all said debris and transporting it to said debris reservoir of said vacuum system;
- 6 the retrieval device of claim 5 including a stop ring fixedly attached to said air tube, whereby the lower extremity of said filter element is brought into contact with said stop ring to define a discrete third longitudinal position, in which all of said filter orifices and said air passages of said air tube are then in the most favorable alignment for said self-cleaning, aided by rotating said filter element

freely through 360 degrees;

- 7 the retrieval device of claim 6 including means to discharge captured articles, wherein said jar incorporates a discharge orifice within the web portion of said jar bottom at an optimum radial distance from its center; said discharge means further including a flat, substantially disk-like discharge plate mounted rotatably to said sleeve portion of said jar, said discharge plate incorporating an aperture similar in size and radial position to said discharge orifice in said jar, said discharge plate having one of its surfaces in direct abutment with the external surface of said jar, whereas said discharge plate may be manually rotated to a radial position in which said aperture in said discharge plate is aligned with said discharge orifice of said jar, thereby allowing captured articles to be extracted from said retrieval device without removing said jar;
- 8 the retrieval device of claim 7 wherein said discharge plate includes detent means for precise positioning of said discharge plate in the full open position and in one or more closed positions.
- 9 the retrieval device of claim 7 wherein said discharge plate is comprised of transparent material and the bottom surface of said discharge plate includes a mirror coating, thereby making said captured articles appear as double images for enhanced recognition;
- 10 the retrieval device of claim 6 including alternate means for discharging captured articles, wherein said jar includes an inwardly inclined bottom surface having a plurality of discharge openings, and an elongated sleeve portion rotatably and slidably adapted to said air tube, a seal ring defining a circular cone shaped rim with a contiguous cylindrical bushing portion, whereas said cylindrical bushing portion mounts slidably over the outer surface of said elongated sleeve portion of said jar, and said cone shaped rim closely abuts the external surface of said

inclined bottom portion of said jar, so as to completely cover said plurality of discharge openings and thus prevent egress and ingress when said seal ring is slidably disposed in a first closed position with respect to said elongated sleeve portion, yet permit full egress and ingress when said seal ring is disposed in a second open position, whereby said captured articles fall into and are temporarily retained by said cone shaped rim;

- 11 the retrieval device of claim 10 wherein said seal ring is comprised of transparent material and the bottom surface of said seal ring includes a mirror coating, thereby making said captured articles appear as double images for enhanced recognition;
- 12 the retrieval device of claim 1 including a flexible hose sized to permit clear passage of the article or articles to be retrieved, and of a length suitable to reach said articles in places of restricted access, adaptably mounted at the intake end of said air tube;
- 13 the retrieval device according to claim 1 including means to diminish the air volume and velocity at said primary inlet opening, comprising: an annular depression disposed adjacent to said final outlet opening of said air tube including a plurality of air inlet slots congregated on one side of said air tube within said annular depression, a cylindrical collar mounted in said annular depression in snug rotatable relation, said collar having part of its circumference removed to expose the entire said plurality of air inlet slots when in a first rotational position, and covering said plurality of air inlet slots one by one when rotated away from said first position to a second position disposed 180 degrees from the first so as to cover all of said air inlet slots, whereby air volume and velocity at said primary inlet opening is greatest with said collar rotated to said second position, and least when rotated to said first position;
- 14 a retrieval device for capturing and recovering small articles, operated by a

moving air stream by adaptably connecting it to a vacuum cleaning system, said retrieval device comprising:

a rigid elongated annular air tube including a primary inlet opening, a medial region defining an intermediate air exit passage, internal diverting means cooperating with said intermediate air exit passage in re-directing the air stream, one or more air re-entry passages extended away from said intermediate air exit passage, and a final outlet opening, whereby the air stream enters said air tube at said primary inlet opening, flows toward said diverting means, exits said air tube through said intermediate air exit passage, re-enters through one or more of said air re-entry passages, then exits said retrieval device through said final outlet opening;

a hub mounted rotatably and slidably on said air tube, including first positioning means, whereby said hub is continually held in a discrete first longitudinal position with respect to said air tube, while being free to rotate about its center through 360 degrees in either direction, said hub also including second positioning means, whereby said hub is simultaneously held in a discrete first radial position with respect to said air tube, said second positioning means also providing for additional discrete radial positions of said hub for aligning multiple internal air passages, and said hub further including a circular portion extending radially outward with a flange at its distal perimeter, said circular portion and said flange defining the top closure of the next element;

a jar of substantially cylindrical shape, comprised of a translucent plastic material for providing a clear view of its contents, fixedly mounted at its upper extremity to said flange of said hub by means permitting manual removal, said jar including a bottom surface and a sleeve portion rotatably and slidably adapted to said air tube, whereas said jar forms a vacuum tight compartment surrounding said air tube in the area encompassing said intermediate air exit passage and said air re-entry

passages, thereby enabling continual airflow between the said internal air passages, whereby every object traveling within the air stream must traverse, at a minimum, the space within said jar between said intermediate air exit passage and said air re-entry passages;

a multiple filter element, substantially cylindrical in shape, mounted fixedly to said hub, surrounding said air tube in close rotatable and slidable contact, said multiple filter element including two or more filtering zones, whereby one zone incorporates a multiplicity of filtering orifices of one uniform size, the next zone incorporates a multiplicity of filtering orifices of another uniform size etc., combined with means for bringing certain of said filtering zones into alignment with certain of said air re-entry passages of said air tube whenever said hub is in said first longitudinal position and in one of said discrete radial positions, whereby the air stream exits said air tube through said intermediate air exit passage and re-enters it by passing through the largest of said filtering orifices that are in alignment with said air re-entry passages by virtue of having selected the corresponding one of said discrete radial positions, thereby causing objects transported by the air stream which are smaller than said filtering orifices to pass freely through, and causing objects larger than said filtering orifices to remain trapped within said jar between said filter element and said intermediate air exit passage;

- 15 the retrieval device according to claim 14, whereby said second positioning means comprise a detent mechanism for precise radial alignment of said internal passages in each position;
- 16 the retrieval device of claim 15, including visual indicating means for displaying suitable signage representing each of said discrete radial positions of said hub when hub is stopped in said radial position by said detent mechanism;